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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/942,907	08/31/2001	Tsuneo Ikura	740819-640	8137

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EXAMINER

THOMAS, TONIAE M

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 01/16/2003

6

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/942,907

Applicant(s)

IKURA, TSUNEO

Examiner

Toniae M. Thomas

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 November 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 August 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Introduction

1. This Office action is responsive to the request for reconsideration filed on 04 November 2002. Currently, claims 1-6 are pending.
2. The indicated allowability of claim 2 is withdrawn in view of the newly discovered reference to US 6,255,151 B1. Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

3. *Claim 5 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.*

Claim 5 recites, "the step...includes a sub-step of removing the second mask pattern in forming a lower portion of said first interconnect groove in said first insulating film through the selective etching using said second mask pattern."

The second mask pattern cannot be used in the forming of the lower portion of the first interconnect groove if it has been removed. Therefore, the phrase "through the selective etching using said second mask pattern" should be deleted.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. *Claims 1, 3, 4, and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sung (US 5,858,831 B1) in view of Huang (US 6,187,624 B1) and Lee et al. (US 6,077,738 B1).*

Sung discloses a method for fabricating a semiconductor device (figs. 16-20 and col. 7, line 19 - col. 8, line 44). The method comprises the following steps: forming a first insulating film 34 on a substrate 1 (fig. 17); patterning the first insulating film through selective etching using a first mask pattern 35 formed on a first region of the first insulating film (fig. 17); forming a second insulating film 40 on the substrate, the second insulating film having a relatively high dielectric constant and high mechanical strength (fig. 20 and col. 8, lines 27-29); forming first and second interconnect grooves 42, 43 in the second insulating film and the patterned first insulating film through selective etching using a second mask pattern formed on the second insulating film (fig. 20 and col. 8, lines 29-36); and forming a buried interconnect 45 in the first interconnect groove 42 (fig. 20).

Sung further discloses forming both the first and second insulating films to include inorganic materials as principal constituents.

Sung lacks anticipation in not teaching the following limitation: [1] forming the first insulating film 34 with a relatively low dielectric constant and low mechanical strength; [2] forming a thinned portion of the second insulating film 40 by polishing the second insulating film; and [3] forming the first insulating layer to include an organic material as a principal constituent.

Huang discloses a method for forming a semiconductor device that is compatible with Sung (figs. 8-12 and col. 6, line 50 - col. 7, line 65). The method comprises the steps of: forming a first insulating film 42, with a relatively low dielectric constant and low mechanical strength, on a substrate 10 (fig. 8 and col. 6, lines 50-62); patterning the first insulating film through selective etching (fig. 9 and col. 6, lines 63-67); forming a second insulating film 50, with a relatively high dielectric constant and high mechanical strength, on the substrate (fig. 12 and col. 7, lines 41-48). The first insulating film includes an organic material as a principal constituent (col. 6, lines 54-59).

Lee et al. disclose a method for forming a semiconductor device that is compatible with Sung (figs. 3-10 and col. 3, line 64 - col. 6, line 17). The method comprises the steps of: forming a first insulating film 17 on a substrate 1 (fig. 3); patterning the first insulating film through selective etching (fig. 5); forming a second insulating film 28 on the substrate (fig. 10); and forming a thinned portion of the second insulating film by using a polishing method, CMP, to planarize the second insulating film (col. 6, lines 1-9).

One having ordinary skill in the art would have been motivated to modify the process of Sung by [1] forming the first insulating film with a relatively low dielectric

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constant and low mechanical strength and [2] forming a thinned portion of the second insulating film by polishing the second insulating film, as taught by Huang and Lee et al., respectively, because of the following reasons: the low dielectric constant material reduces the parasitic capacitance between adjacent capacitors (Huang - col. 7, lines 49-52); and the planarized second insulating film provides a smooth top surface topography for the series of insulator layers overlying both the peripheral region and DRAM region (Lee et al. - col. 6, lines 4-9).

Lee et al. do not teach that the thinned portion of the second insulating film has a thickness of 10nm to 50nm. However, given the general process disclosed in the prior art, it would have been within the ability of one having ordinary skill in the art to discover the claimed range of thickness through routine experimentation. "Where general conditions of [a] claim are disclosed in prior art, it is not inventive to discover optimum or workable ranges by routine experimentation" (see *In re Aller, Lacey, and Hall* 105 USPQ 233 (CCPA 1955)). Therefore, the claimed range of thickness for the thinned portion of the second insulating film is taken to be obvious over the combination of Sung, Huang, and Lee et al.

5. *Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sung in view of Huang and Lee et al. as applied to claim 1 above, and further in view of Fukuda et al. (6,255,151 B1).*

Sung does not teach the step of forming a third insulating film to prevent diffusion of the buried interconnect.

Fukuda et al. disclose a method that is compatible with Sung (figs. 12-24 and col. 18, line 27 - col. 20, line 60). The method comprises forming a third insulating film 35 of silicon nitride on a thinned portion of a second insulating film 30, which is formed on a patterned first insulating film 24 (fig. 24). The silicon nitride film prevents the diffusion of copper from the buried interconnect 32 (col. 20, lines 58-60).

The buried interconnects 42 and 43 of Sung comprise a thin underlying layer of titanium, a thin layer of titanium nitride, and a layer of either tungsten or aluminum-copper (col. 8, lines 36-42). In the embodiment wherein aluminum-copper is used as the layer for the buried interconnects, one having ordinary skill in the art would have been motivated to modify the process of Sung, Huang, and Lee et al. by forming a third insulating film of silicon nitride, as taught by Fukuda et al., for preventing the diffusion of the copper in the buried interconnect. In the instance where tungsten is used instead of an aluminum-copper alloy, the silicon nitride insulating film will prevent the diffusion of tungsten as well.

Allowable Subject Matter

6. *Claim 5 contains allowable subject matter.* Sung, Huang, Lee et al., and Fukuda et al. do not anticipate, teach or suggest the following limitation recited in claim 5, either when considered separately or when combined: in the step of forming the first interconnect groove, removing the second mask pattern in forming a lower portion of the first interconnect groove in the first insulating.

Response to Arguments

7. Applicant's arguments with respect to claims 1 and 3-6 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toniae M. Thomas whose telephone number is (703) 305-7646. The examiner can normally be reached on Monday through Thursday from 8:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-3432 for regular communications and (703) 305-3432 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JMJ

January 8, 2003


AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800